Condensed Matter physics

ELECTRIC FIELD INDUCED PHASE TRANSITION IN THE FERROELECTRIC PHASE (Sm C *) OF THE LIQUID CRYSTAL CE-8

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Ferroelectric liquid crystals (FLC) find applications in display technology because of their electrooptic effects (electric field induced changes in the optical properties). The present research is devoted to the study of the elecrooptical characteristics of the chiral liquid crystal 4-(2'methylbutyl)phenyl 4'-n-octylbiphenyl-4-carboxylate referred to as CE-8.

Most FLC used in device applications have the chiral sm-C (Sm-C*) phase. In this phase, the constituent molecule is chiral in nature (i.e., without any mirror plane symmetry) and possesses a permanent transverse dipole moment and hence each layer of the Sm-C* phase exhibits a spontaneous polarization. In the Sm-C* phase the polarization vector is parallel to the smectic layer plane and perpendicular to the tilted director. As a consequence of the molecular chirality, the director builds up a helical superstructure by precessing around the layer normal as one moves from one layer to another layer. The corresponding helical pitch amounts to usually several μm, but the distance between layers remain the same as that of non-chiral Sm-C phase, i.e. ~ the molecular length. A dc electric field of sufficient strength (critical electric field) unwinds the helical structure by aligning the polarization vectors of the smectic layers parallel to the field direction , thus producing a homogenous orientation of the director. If the electric field strength is weaker than the critical field the helix will be deformed (Deformed Helix Mode) but not completely unwound. Display devices making use of the deformed helix mode normally employ a Sm-C* phase whose pitch is smaller than the wave length of the visible light. Here, we have studied a case where the pitch is larger than the wavelengths of visible light.

Our CE-8 samples were prepared in the so called bookshelf geometry and the electric field was applied perpendicular to the helix. The sample was placed between the crossed polarizers with the helical axis parallel to one of the polarization axes (low transmission state). Due to the application of the electric field the transmitted light intensity initially decreases with the electric field and then it is followed by a discontinuous jump to a state of high transmission at some threshold field indicating phase transition to Sm-A (paraelectric) phase. Decreasing the field reveals an obvious hysteresis behavior which is a result of the competition between the applied electric field, the aligning surface anchoring effects, and the internal twisting forces of the Sm-C* phase. The results of our investigation of the temperature effects on the hysteresis curves and the unwinding critical electric field will be presented.

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